Remarks

The Examiner's Office Action rejects all claims presented for Examination based upon the Aho book, and specifically Fig. 10.21 of that book. The Examiner relies upon the relationships between in[S], out[S], gen[S] and kill[S], and an analogy to the steps of claim 12.

Applicant notes, however, that claim 12, and therefore all claims, is directed to a "method of calculating approximations of sets of entry and exit properties ... prior to performance of an iterative dataflow analysis" and the iterative dataflow analysis is described as one which "does not increase the membership of [the] sets".

Aho provides algorithms for computing in[S] and out[S], in section 10.6, and these are distinctly different from what is claimed. The Aho book provides several examples of dataflow analysis, but none match what is claimed. Generally, there are two categories of dataflow algorithms described:

- An algorithm that initializes in[S] and out[S] to have no members, and then performs an iterative process which adds members to in[S] and out[S]. This is the case in Algorithm 10.2 on page 625 which "start[s] with the 'estimate' $in[B] = \emptyset$ for all B and converg[es] to the desired values of *in* and *out*".

- An algorithm that initializes in[S] and out[S] to have all possible members, and then performs an iterative process which deletes members from in[S] and out[S]. This is the case in

Algorithm 10.3 on page 631 which starts with an "initial estimate [which] is too large", computed by "*out*[*B*] = *U* - *e_kill*[*B*]"; that is, Algorithm 10.3 starts by assuming that every expression except those killed by B are in *out*[*B*], and then eliminates expressions from this large universe, through iterations of the process.

Applicant submits that the claimed invention is an algorithm which is neither of the above. Unlike the first, the claimed invention uses an iterative dataflow analysis that does not increase the membership of sets. And unlike the second, the claimed invention does not assume an excessively large initial membership of the initial values of in[S] and out[S] (which, in algorithm 10.3, can be as large as the entire universe U of expressions).

As explained in the Application at page 20, a gross overestimation of in[S] and out[S], as is typically used in dataflow analysis algorithms like algorithm 10.3, does not present a problem with a conventional bit-vector representation for in[S] and out[S]. However, when there is an unconventional representations of in[S] and out[S], such as the skip-list representation invented by the inventor and disclosed in this application (and claimed by the parent application, now U.S. Patent 6,117,185), and this unconventional representation is "not efficent in representing densely populated sets", a gross overestimation of in[S] and out[S] can be debilitating. In the

presently claimed invention, therefore, "a novel methodology is used to initialize the sets **in**[.] and **out**[.]. This methodology is based on the recognition that (1) the dataflow analysis conducted in accordance with Fig. 4 only reduces the number of members in these sets, and (2) it is only necessary that **in**[.] and **out**[.] initially include all members that might be included after dataflow analysis. If a simplified analysis of the blocks B in the CFG can identify all of the members that might possibly be included in the **in**[.] and **out**[.] sets after a complete data flow analysis, then only those members that might possibly be included need be included when the **in**[.] and **out**[.] sets are initialized."

The present invention provides just such an initialization process that allows the use of the unconventional and advantageous skip-list representation that is the subject of the sibling patent 6,117,185. Applicant submits that nothing in the Aho confronts or would provide any initialization process of this kind, as Aho assumes a bit-vector representation of the sets in[S] and out[S] (see page 618, under "Representation of Sets"). Specifically, Aho does not provide an initialization process that is at all analogous to the steps recited in claim 12.

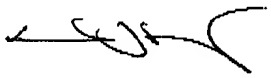
Applicant has amended claim 12 simply to include, as a positive step, the performance of the iterative dataflow analysis; this element was already recited by the preamble of the claim, so this is not a change in scope but merely a further

clarification that what is recited by the claim is the initialization, and not the analysis itself. As noted, nothing in Aho teaches an initialization like that which is recited by claim 12, and therefore all claims.

In view of the above, Applicant submits that all claims are allowable and requests issuance of a Notice of Allowability.

If any petition for extension of time is necessary to accompany this communication, please consider this paper a petition for such an extension of time, and apply the appropriate extension of time fee to Deposit Account 23-3000. If any other charges or credits are necessary to complete this communication, please apply them to Deposit Account 23-3000.

Respectfully submitted,



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